DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1, 6-10 and 21-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamashita (JP 62-266053 A; an english translation is cited) in view of Inoue (US 2001/0021269).

a. Regarding claim 1, Yamashita discloses a bone mineral density evaluation system for evaluating a bone mineral density from an X-ray picture of a mandible, said X-ray picture containing a picture of an artificial reference specimen disposed beside a picture of said mandible, said X-ray picture resulting from x-raying said artificial reference specimen disposed in such a position that said picture of said artificial reference specimen is positioned beside said picture of said mandible in said X-ray picture, said system comprising:

detecting means for detecting a gradation of a particular portion of said picture of said artificial reference specimen (FIGURE 1; “to obtain an X-ray image of an alveolar bone, an upper or lower jaw about a centeral incisor may be X-rayed with an aluminum staircase inserted as a reference substance” at page 3, lines 13-15);

evaluating means for evaluating the bone mineral density ("three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27);

wherein:

said evaluating means makes evaluation of a particular region of said mandible in said X-ray picture ("three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27); and said particular region includes a region corresponding to an alveolar bone portion around a first premolar ("three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27).

However Yamashita does not disclose correcting means for correcting the gradation of said X-ray picture so as to make the gradation of said particular portion of said picture of said artificial reference specimen as detected by said detecting means comply with a preset standard.

Instead of Yamashita, Inoue, the same field of endeavor of medical digital x-ray image processing, discloses correcting means for correcting (Fig. 1; "convert an input image from which the histogram 101 is obtained to an aimed image (image in an ideal state) for which the histogram 102 is obtained" at ¶¶ 0052 and 0057) the gradation of said X-ray picture (Fig. 1-101, "histogram of input image"; "histogram of an X-ray dose (pixel value) of an image (input image) of a specific field of a subject" at ¶0047) so as to make the gradation of said particular portion of said picture of said artificial reference

specimen (Fig. 1-101, "histogram of input image"; "histogram of an X-ray dose (pixel value) of an image (input image) of a specific field of a subject" at ¶0047) as detected by said detecting means comply (Fig. 1-106, "broadly equalized histogram"; "[G]enerally equalized histogram is captuered" at ¶¶ 0050 and 0051) with a standard value (Fig. 1-102, "aimed histogram"; a histogram (aimed histogram) of an X-ray dose (pixel value) of an image in an ideal state (hereinafter referred to as "an aimed image") of a specific field (identical with a field in an input image) of a subject" at ¶ 0051).

Choel and Yamashita are combinable because they are all related to the field of medical digital x-ray image processing.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to applying the steps of detecting the "histogram of an X-ray dose (pixel value) of an image (input image) of a specific field of a subject" (Inoue; Fig. 101; ¶ 0047) and "converting an input image[,] from which the histogram 101 is obtained [,] to an aimed image (image in an ideal state)[,] for which the histogram 102 is obtained" (Inoue; Fig. 1; ¶¶ 0052 and 0057), using "the generally equalized histogram [being] captured" (Inoue; Fig. 1-106; ¶ 0050 and 0051) taught by Inoue in the process of Yamashita.

The suggestion/motivation for doing so would have been to provide "more objective and quantitative evaluation" (Yamashita; page 5, lines 25-31).

Therefore, it would have been obvious to combine Yamashita and Inoue to obtain the invention as recited in claim 1.

b. Regarding claim 6, the combination of Yamashita and Inoue, as applied in claim 1, discloses all the previous claim limitations. Moreover, Inoue discloses further

comprising setting means for setting said standard value ("setting a form of an ideal histogram" at ¶ 0067).

c. Regarding claim 7, the combination of Yamashita and Inoue, as applied in claim 1, discloses wherein said standard value (Inoue; Fig. 1-102, "aimed histogram"; a histogram (aimed histogram) of an X-ray dose (pixel value) of an image in an ideal state (hereinafter referred to as "an aimed image") of a specific field (identical with a field in an input image) of a subject" at ¶ 0051) being set based on a result of detection by said detecting means of a particular X-ray picture (Inoue; "The author discloses the aimed histogram is a specific field, which is identical with a field in an input image that is captured by X-ray photographing, of a subject. The specific field of the subject, which is a human body disclosed in Inoue, is the result of detection by the detecting means of a X-ray photography" ¶ 0047 and 0051).

d. Regarding claim 8, the combination of Yamashita and Inoue, as applied in claim 1, discloses all the previous claim limitation including wherein said evaluating means (Yamashita; "three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27). Moreover, Inoue discloses display means (Fig. 3-310; "display" at ¶ 0118) for displaying said corrected gradation in the form of histogram (Fig. 3-307; "The author discloses that a histogram, which is created after gradation conversion has passed through the memory, is displayed on the display as the histogram" at ¶ 0118).

e. Regarding claim 9, the combination of Yamashita and Inoue, as applied in claim 1, discloses wherein said evaluating means includes judging means for judging said bone mineral density (Yamashita; pages 6-8) on the basis of said corrected gradation (Inoue; Fig. 1; "convert an input image from which the histogram 101 is obtained to an aimed image (image in an ideal state) for which the histogram 102 is obtained" at ¶¶ 0052 and 0057).

f. Regarding claim 10, the combination of Yamashita and Inoue, as applied in claim 1, discloses further comprising output means for providing together a plurality of evaluation results provided by said evaluating means for respective ones of a plurality of X-ray pictures (Yamashita; pages 6-8).

g. Regarding claim 21, the combination of Yamashita and Inouse does disclose expressly that said artificial reference specimen is an aluminum block (Yamashita; Figure 2; "aluminum staircase" at page 4, line 22).

h. Regarding claim 22, the combination of Yamashita and Inouse discloses expressly that said artificial reference specimen is an aluminum block being a stepped structure (Yamashita; Figure 2; "aluminum staircase" at page 4, line 22).

i. Regarding claim 23, claim 23 is analogous and corresponds to claim 22. See rejection of claim 22 for further explanation.

3. Claims 12-14 and 16-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yamashita (JP 62-266053 A; an english translation is cited) in view of Kim (US 6,078,686).

a. Regarding claim 12, Yamashita discloses a bone mineral density evaluation system for evaluating a bone mineral density from an X-ray picture of a mandible, said X-ray picture containing a picture of an artificial reference specimen disposed beside a picture of said mandible, said X-ray picture resulting from x-raying said artificial reference specimen disposed in such a position that said picture of said artificial reference specimen is positioned beside said picture of said mandible in said X-ray picture, said system comprising:

detecting means for detecting a gradation of a particular portion of said picture of said artificial reference specimen (FIGURE 1; "to obtain an X-ray image of an alveolar bone, an upper or lower jaw about a centeral incisor may be X-rayed with an aluminum staircase inserted as a reference substance" at page 3, lines 13-15);

evaluating means for evaluating the bone mineral density ("three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27);

wherein:

said evaluating means makes evaluation of a particular region of said mandible in said X-ray picture ("three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27); and said particular region includes a region corresponding to an alveolar bone portion around a first premolar ("three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27).

However, Yamashita does not disclose detecting means for detecting an average and a deviation of the gradation of said picture and correcting means for correcting the gradation of said X-ray picture so as to make the average and the deviation as detected by said detecting means comply with a preset standard average and a preset standard deviation.

Instead of Yamashita, Kim, the same field of endeavor of image processing, discloses detecting means for detecting an average (FIG. 4-304, “frame mean calculator; “A frame mean calculator calculates the mean level (X_m)” at col. 8, lines 38-39) and a deviation (FIGs. 4-308, “a first CDF calculator” and 4-310, “a second CDF calculator”; equations (15) and (16); “calculate[ing] a cumulative density function (CDF) $c_L(X_k)$… calculate[ing] a cumulative density function (CDF) $c_U(X_k)$” at col. 8, lines 63-67 to col. 9, lines 1-18) of the gradation of said picture (“[A]n input image signal {Y} [being] comprised of L discrete level represented by $\{\{X_0, X_1, ..., X_{L-1}\}$” at col. 8, lines 36-37) and

correcting means for correcting the gradation (equation (18); "equalized output (Yo)” at col. 10, lines 22-25 and 37-38) of said picture (“[A]n input image signal {Y} [being] comprised of L discrete level represented by $\{\{X_0, X_1, ..., X_{L-1}\}$” at col. 8, lines 36-37) so as to make the average (FIG. 4-304, “frame mean calculator; “A frame mean calculator calculates the mean level (X_m)” at col. 8, lines 38-39) and the deviation (FIGs. 4-308, “a first CDF calculator” and 4-310, “a second CDF calculator”; equations (15) and (16); “calculate[ing] a cumulative density function (CDF) $c_L(X_k)$…

calculate[ing] a cumulative density function (CDF) $c_U(X_k)$" at col. 8, lines 63-67 to col. 9, lines 1-18) as detected by said detecting means comply with a preset standard average (equation (17); "a compensated mean level (B_m) $B_m = X_m + \Delta$" at col. 9, lines 34-35) and a preset standard deviation (equations (18) and (19); "$c_L(X_k)B_m$" and "$B'_m + (X_{L-1} - B'_m)c_U(X_k)$" at col. 10, lines 21-25).

Yamashita and Kim are combinable because they are all related to the field of image processing.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply the "contrast enhancer" (KIM; FIG. 1-300; col. 8, lines 29-30) comprising "the frame mean calculator" (Kim; FIG. 4-304; col. 8, lines 38-39), "the first and second CDF calculator (Kim; equations (15) and (16); FIGS. 4-308 and 4-310; col. 8, lines 63-67 to col. 9, lines 1-18), "brightness compensator" (Kim; FIG. 4-314; col. 9, lines 29-67) and "the first and second mapper" (Kim; FIGS. 4-316 and 318; col. 10, lines 5-36) taught by Kim in in the process of Yamashita

The suggestion/motivation for doing so would have been to provide "a contrast enhancer based on mean-separate histogram equalization having … brightness compensation" (Kim; col. 4, lines 36-41) for "image quality enhancing" (Kim; col. 4, line 37), and especially, when the "mean-separated histogram equalization is applied, an abrupt change in brightness and artifacts, which can be generated after a general histogram equalization when an input image has a concentrated distributed histogram, can be effectively prevented" (Kim; col. 4, lines 46-51).

Therefore, it would have been obvious to combine Yamashita and Kim to obtain the invention as recited in claim 12.

b. Regarding claim 13, the combination of Yamashita and Kim, as applied in claim 12, discloses all the previous claim limitations. Moreover, Kim discloses further comprising setting means for setting said standard average and said standard deviation (FIGS. 5a and 5b; "[t]he corrected values (Δ) [being] determined by correction function" at col. 9, lines 43-47).

c. Regarding claim 14, the combination of Yamashita and Kim, as applied in claim 12, discloses wherein said standard average (Kim; equation (17); "a compensated mean level (B_m) $B_m = X_m + \Delta$" at col. 9, lines 34-35) and said standard deviation (Kim; equations (18) and (19); "$c_L(X_k)B_m$" and "$B'_m+(X_{L-1} - B'_m)c_U(X_k)$" at col. 10, lines 21-25) being set based on a result of detection by said detecting means (Kim; FIG. 4-304, "frame mean calculator; "A frame mean calculator calculates the mean level (X_m)" at col. 8, lines 38-39; FIGs. 4-308, "a first CDF calculator" and 4-310, "a second CDF calculator"; equations (15) and (16); "calculate[ing] a cumulative density function (CDF) $c_L(X_k)$... calculate[ing] a cumulative density function (CDF) $c_U(X_k)$" at col. 8, lines 63-67 to col. 9, lines 1-18) of a particular X-ray picture.

d. Regarding claim 16, the combination of Yamashita and Kim, as applied in claim 12, discloses wherein said evaluating means including judging means for judging said bone mineral density (Yamashita; pages 6-8).

e. Regarding claim 17, the combination of Yamashita and Kim, as applied in claim 12, discloses further comprising output means for providing together a plurality of

evaluation results provided by said evaluating means (Yamashita; pages 6-8).f.

Regarding claim 18, the combination of Choel and Kim does not disclose expressly that said artificial reference specimen is an aluminum block. Instead, Chole indicates that said artificial reference specimen is from Ex vivo materials (page 365).

At the time the invention was made, it would have been an obvious matter of design choice to a person of ordinary skill in the art to use Chole's Ex vivo materials because Applicant has not disclosed that the artificial reference specimen being an aluminum block provides an advantage, is used for a particular purpose, or solves a stated problem. One of ordinary skill in the art, furthermore, would have expected Choel's Ex vivo materials, and applicant's invention, to perform equally well with either using the claim specified in claim 18 or Choel's Ex vivo materials.

Therefore, it would have been obvious to modify Choel's to obtain the invention as specified in claim 18 because such a modification would have been considered a mere design consideration which fails to patentably distinguish over the prior art of Choel.

g. Regarding claim 19, the combination of Choel and Kim does not disclose expressly that said artificial reference specimen is an aluminum block being a stepped structure(Yamashita; Figure 2; "aluminum staircase" at page 4, line 22).

h. Regarding claim 20, claim 20 is analogous and corresponds to claim 19. See rejection of claim 19 for further explanation.

4. Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Yamashita (JP 62-266053 A; an english translation is cited) in view of Kim (US 6,078,686), and further in view of Inoue (US 2001/0021269).

a. Regarding claim 15, the combination of Yamashita and Kim, as applied in claim 12, discloses all the previous claim limitation including wherein said evaluating means ("three indexes can be individually used as an index in evaluating the degree of alveolar bone atrophy of a periodontal disease" at page 5, lines 25-27).

However, the combination of Yamashita and Kim does not disclose display means for displaying said corrected gradation in the form of histogram.

Instead of Yamashita and Kim, Inoue, the same field of endeavor of image processing, discloses display means (Fig. 3-310; "display" at ¶ 0118) for displaying said corrected gradation in the form of histogram (Fig. 3-307; "The author discloses that a histogram, which is created after gradation conversion has passed through the memory, is displayed on the display as the histogram" at ¶ 0118).

Yamashita, Kim and Inoue are combinable because they are all related to the field of image processing.

At the time of the invention, it would have been obvious to a person of ordinary skill in the art to apply the step of "[t]he created histogram [being] displayed on the display 310 as the histogram 307" (Inoue; Figs. 3-307 and 3-310; ¶ 0118) in the step of the "multiple regression analysis … [which] sex and dental status [being] assessed' (Choel; Table III; Chapter- Material and Methods: Ex vivo materials and Chatper-BMD

differences related to sex, dental status, and anatomic location, pages 365 and 367) of the combination of Yamashita and Kim.

The suggestion/motivation for doing so would have been to provide "[t]he created histogram [being] displayed on the display at the histogram" (Inoue; ¶ 0118) because “an observer can observe most easily" (Inoue; ¶ 0067) "a histogram of an image ... while gradationally converting one or a plurality of images interactively" (Inoue; ¶ 0067).

Therefore, it would have been obvious to combine Yamashita, Kim and Inoue to obtain the invention as specified in claim 15.

Conclusion

5. The prior art made of record is considered pertinent to the disclosure of the application:

- Guillemaud (US 6,296,387 B1): The invention related to a method for correcting image defects from a matrix-type X or γ-ray detector, consisting in producing a confidence map.
- Lang et al. (US 2003/0112921 A1): The invention relates to a method and devices for analyzing x-ray images. In particular, devices , methods and algorithms are provided that allow for the accurate and reliable evaluation of bone structure from x-ray images.

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to JOHN LEE whose telephone number is (571)272-9554. The examiner can normally be reached on Monday - Friday (Alt.) 7:30 a.m. - 5:00 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Samir Ahmed can be reached on (571) 272-7413. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/JOHN W. LEE/
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